

# CLAIMS

[1] A power transistor protective circuit of a motor drive circuit, which has a power transistor provided correspondingly to each of a plurality of exciting coils of a motor for supplying drive current to output terminals connected to one terminals of said exciting coils, comprising:

a terminal open detection circuit;

a breaking detection circuit; and

a drive suspension circuit,

wherein said terminal open detection circuit is provided correspondingly to each of a plurality of power transistors and provided between one of a side of said output terminal and a line connected to said output terminal and one of a side of the other terminal of said exciting coil and an other line connected to the other terminal and, when said power transistor is supplying the drive current to said output terminal connected to said one terminal of said exciting coil, detects an open state of said one terminal side or said the other terminal side,

said breaking detection circuit detects a breaking state or a non-breaking state, when said terminal open detection circuit detects a non-open state and then an open state on said output terminal side or a breaking state on said the other terminal side and

said drive suspension circuit suspends the driving operation of said motor drive circuit when said breaking detection circuit detects the breaking state.

[2] The power transistor protective circuit as claimed in claim 1, wherein said terminal open detection circuit generates a detection signal of an open state or a non-open

state between said one terminal side and said the other terminal side and said braking detecting circuit is provided correspondingly to each of a plurality of power transistors and detects a braking state responsive to the detection signal indicating that said terminal open detection circuit detects a non-open state and then an open state.

[3] The power transistor protective circuit as claimed in claim 2, wherein said terminal open detection circuit detects a difference between a voltage of said one terminal and a voltage of said the other terminal and said braking detection circuit detects a closed state by using the detection signal indicating the non-open state.

[4] The power transistor protective circuit as claimed in claim 3, wherein the braking detection signal of said braking detection circuit is generated after the output operation of the drive current is ended by absence of the detection signal during said power transistor is outputting the drive current.

[5] The power transistor protective circuit as claimed in claim 4, wherein each of said braking detection circuits includes a counter for counting  $n$  clocks having a period  $T$ , where  $n$  is an integer equal to or larger than 2, and said counter is reset according to the detection signal and, when a time from the resetting of said counter to an end of  $n$  counts of said counter is longer than a time between a certain drive current output and a next drive current output, the  $n$  count end signal becomes the braking detection signal.

[6] The power transistor protective circuit as claimed in claim 4, wherein the braking detection signal is generated when a plurality of the detection signals are absent.

[7] The power transistor protective circuit as claimed in

claim 5, wherein each of said terminal open detection circuits includes a first comparator for comparing the voltage of said one terminal with the voltage of said the other terminal of said exciting coil and generating the detection signal as a detection pulse and said breaking detection circuit includes a second comparator for comparing the detection pulse with a predetermined reference voltage and generating the detection signal as a detection pulse and said breaking detection circuit includes a second comparator for comparing the detection pulse with a predetermined reference voltage and generates a signal for resetting said counter according to an output of said second comparator.

[8] The power transistor protective circuit as claimed in claim 6, wherein said drive stop circuit includes an OR gate and a latch circuit, the breaking detection signal from each of said breaking detection circuits is received by said OR gate and latched by said latch circuit and the signal for driving said power transistor is stopped according to an output of said latch circuit.

[9] The power transistor protective circuit as claimed in claim 7, wherein said power transistor generates the drive current sunk from said output terminal as an output current and said the other terminal is connected to a power source line, one of the voltage of said one terminal and said the other terminal is a voltage of said power source line divided by a first voltage divider circuit, a voltage value of the divided voltage being close to a voltage value with which the drive current is limited, the voltage of the other of said the one terminal and said the other terminal is a voltage of said output terminal divided by a second voltage divider circuit.

[10] A power transistor protective circuit of a motor drive circuit, which has a power transistor provided correspondingly to each of a plurality of exciting coils of a motor for supplying drive current to output terminals connected to one terminals of said exciting coils, comprising:

a terminal open detection circuit;

a breaking detection circuit; and

a drive suspension circuit,

wherein said terminal open detection circuit is provided correspondingly to each of a plurality of power transistors and provided between one of a side of said output terminal and a line connected to said output terminal and one of a side of the other terminal of said exciting coil and an other line connected to the other terminal and, when said power transistor is supplying the drive current to said output terminal connected to said one terminal of said exciting coil, detects an open state or a closed state of said one terminal side or said the other terminal side,

said breaking detection circuit detects a breaking state when a plurality of the open states are detected by detecting the open state or the closed state of said terminal open detection circuit, and

said drive suspension circuit suspends the driving operation of said motor drive circuit when said breaking detection circuit detects the breaking state.

[11] The power transistor protective circuit as claimed in claim 10, wherein said breaking detection circuit detects the breaking state when a plurality of the open states occurs continuously.

[12] A motor drive circuit IC for driving said motor with the

output currents of said power transistors, comprising a plurality of said power transistor protective circuits each claimed in any of claims 1 to 11.

[13] A semiconductor device IC comprising a motor drive circuit as claimed in claim 11 or 12.